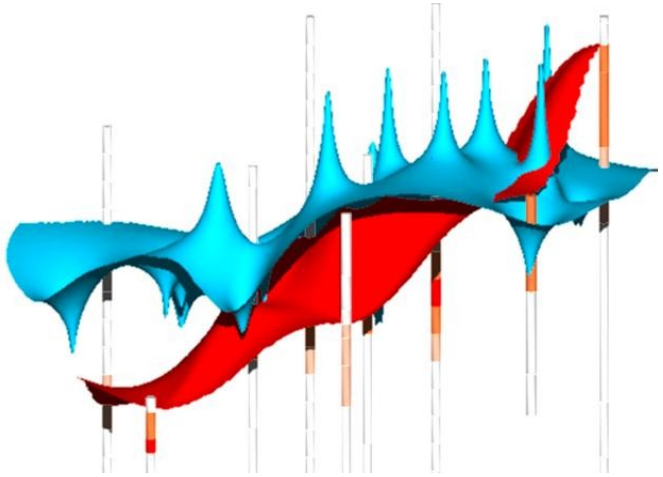
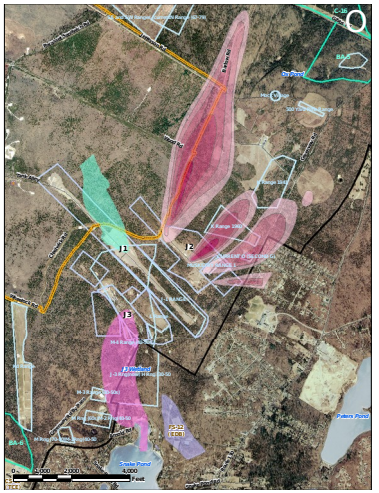
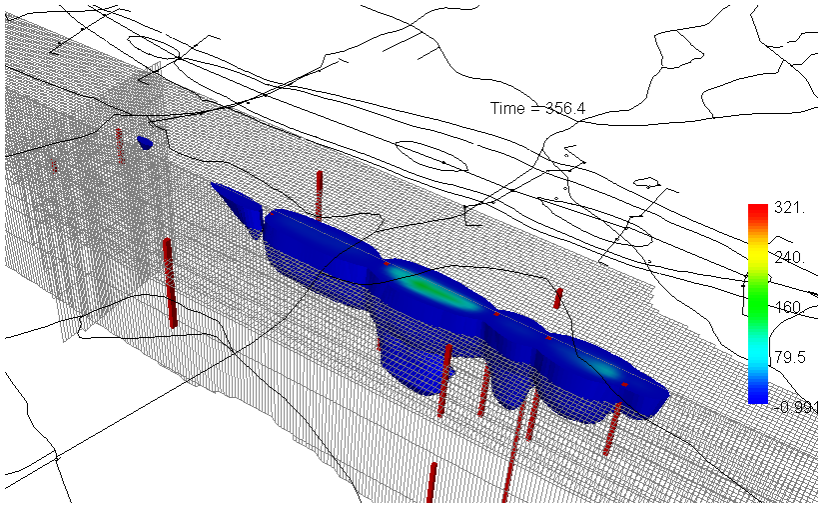
Groundwater Modeling

US Army Corps of Engineers
Philadelphia District





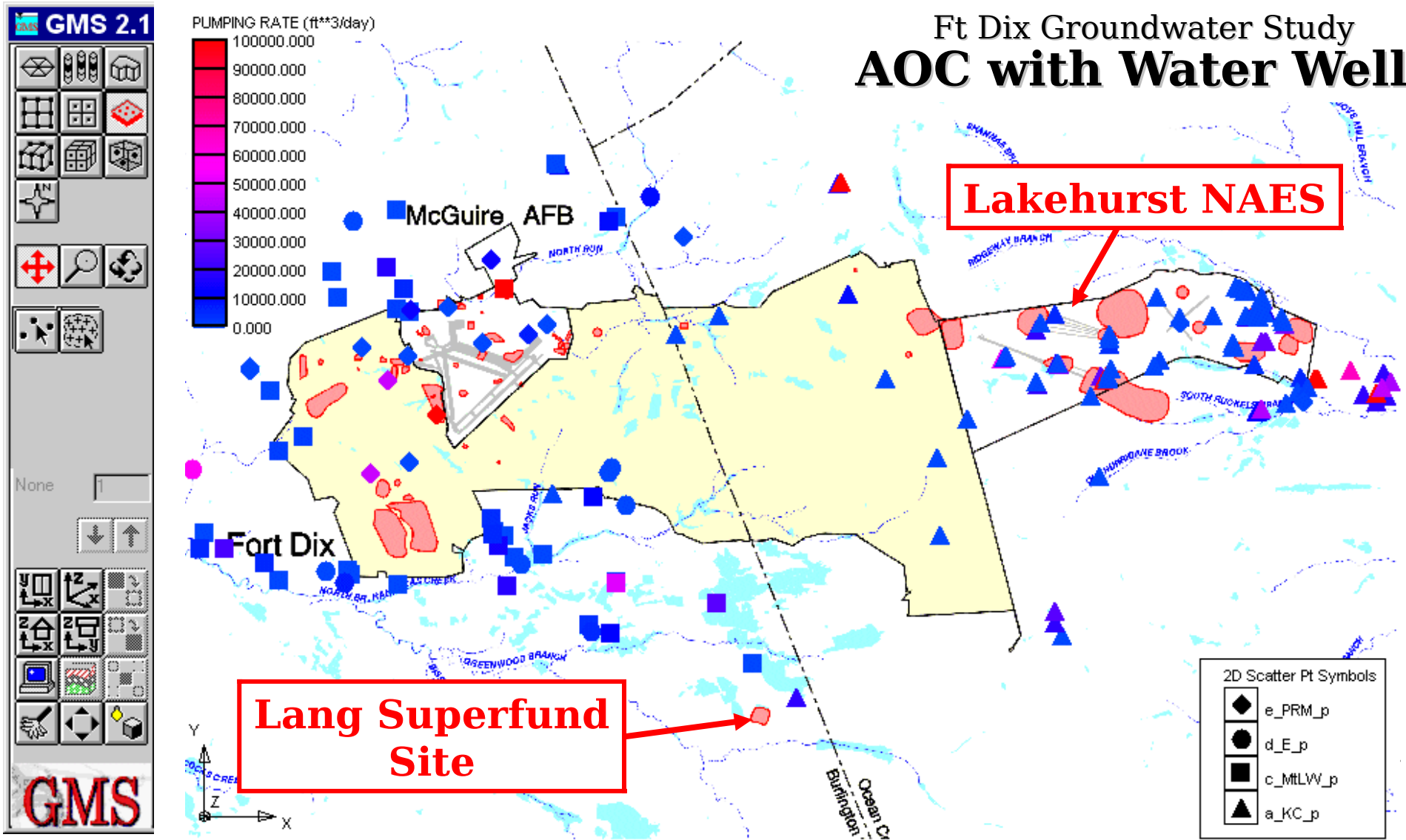






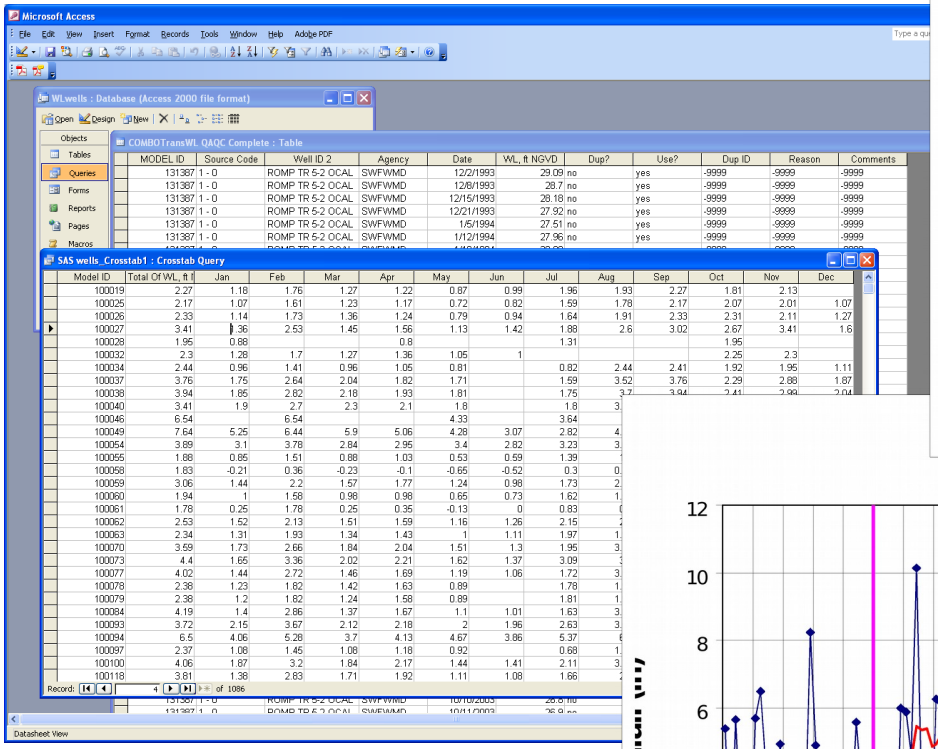
Problem Identification

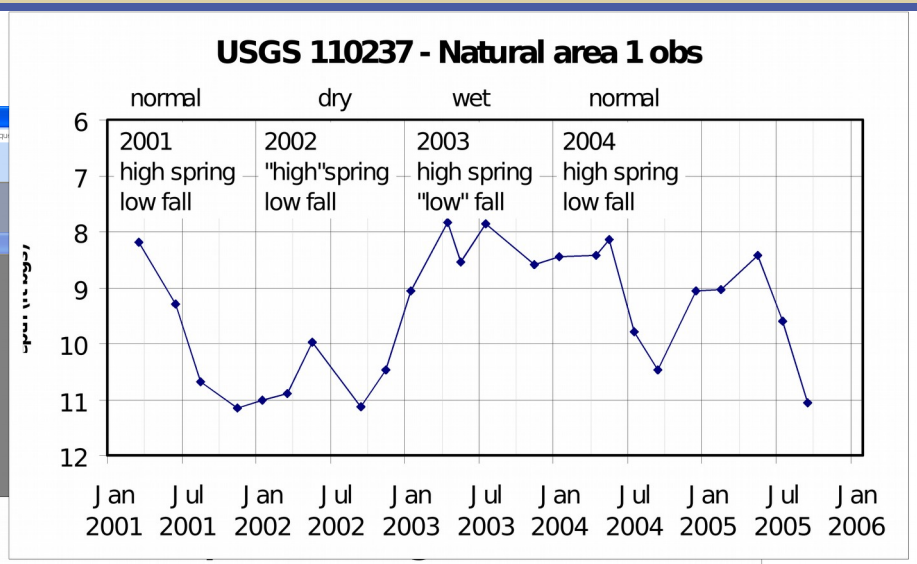
US Army Corps of Engineers
Philadelphia District

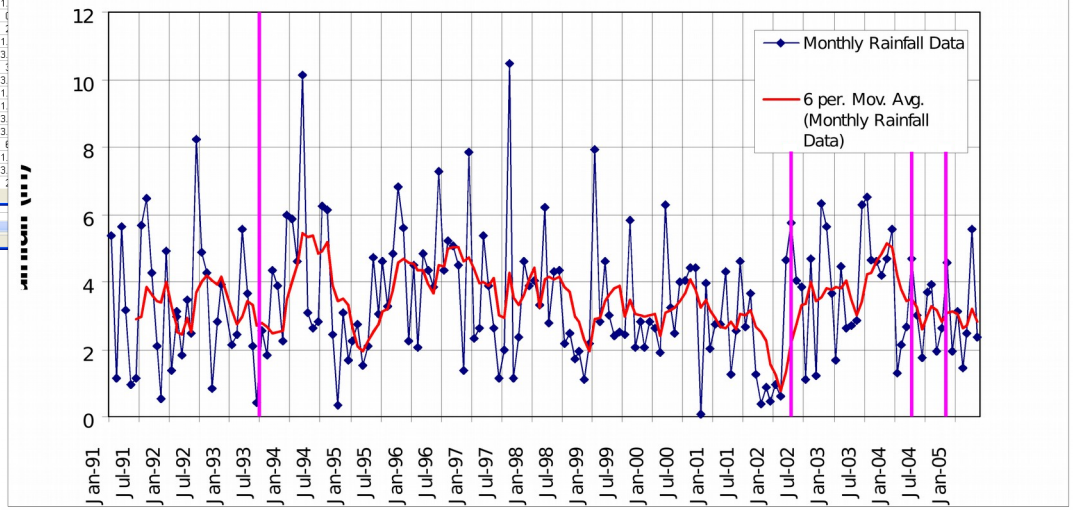


Data Collection and Processing

US Army Corps of Engineers
Philadelphia District







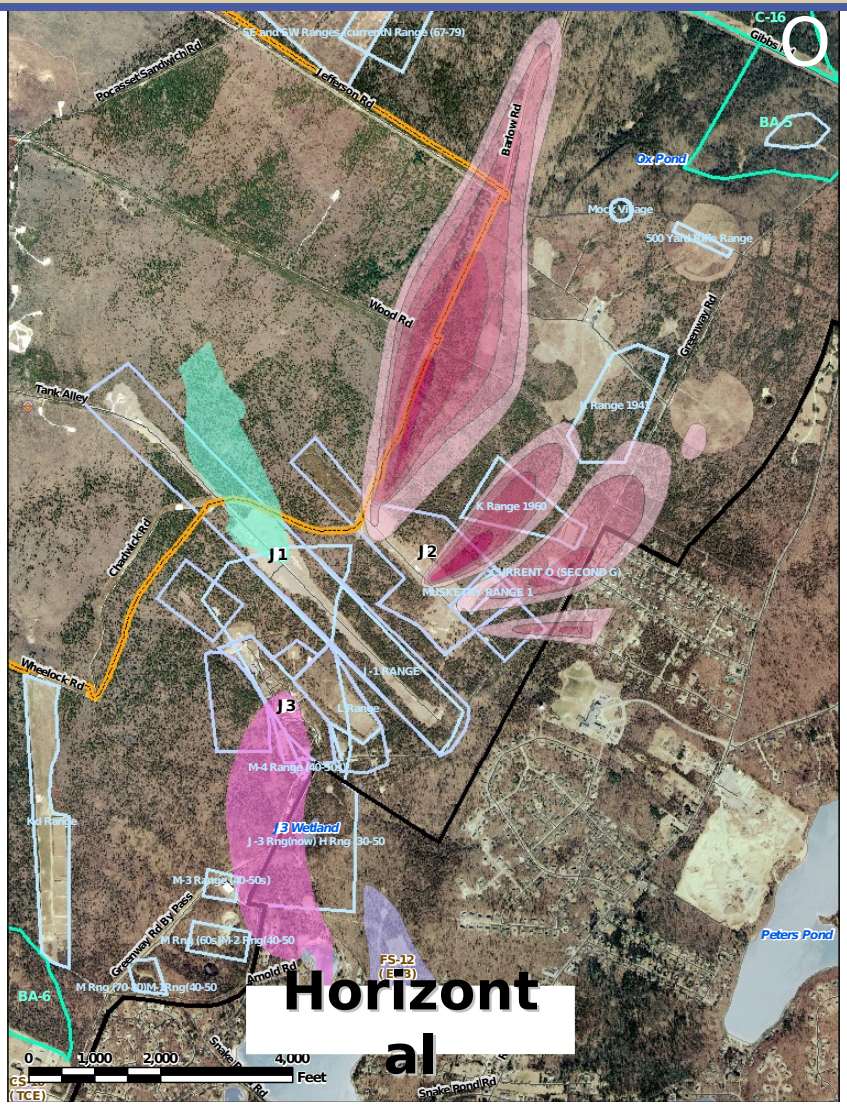
Data Needs

US Army Corps of Engineers
Philadelphia District

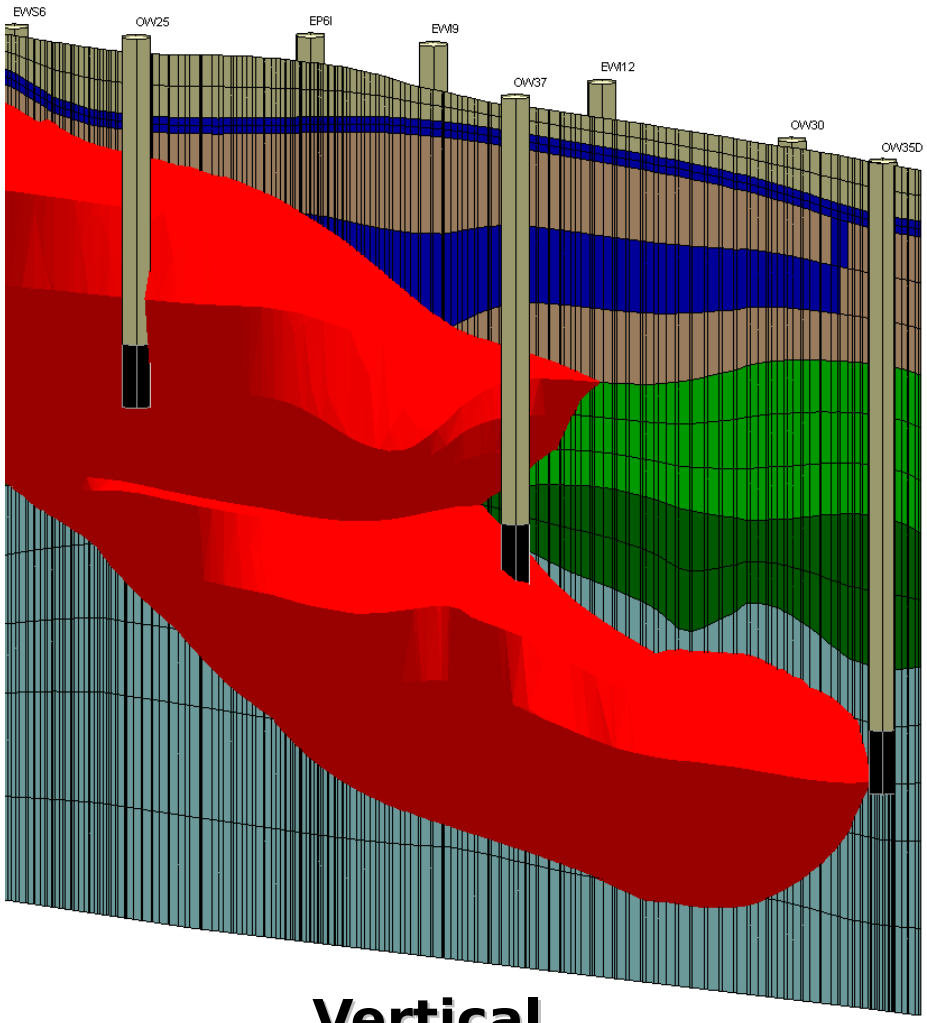
- Topographic
- Surface Water Elevations
- Geologic
- Hydrogeologic
 - Conductivities
 - Groundwater Total Heads
- Climate
 - Rainfall
 - Evapotranspiration
 - Recharge
- Pumping Information
- Irrigation information
- Steady State or Transient
- Contaminates
- Water Chemistry
- Density Flow
 - Salinity
 - NAPL

Data Visualization – Plume Plots

US Army Corps of Engineers
Philadelphia District



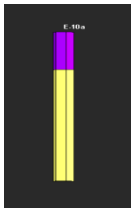
Horizontal



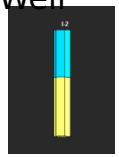
Vertical

Data Visualization – 3-D Site-wide

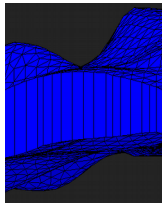
US Army Corps of Engineers
Philadelphia District



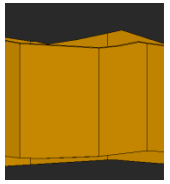
Extraction Well



Injection Well



Trash

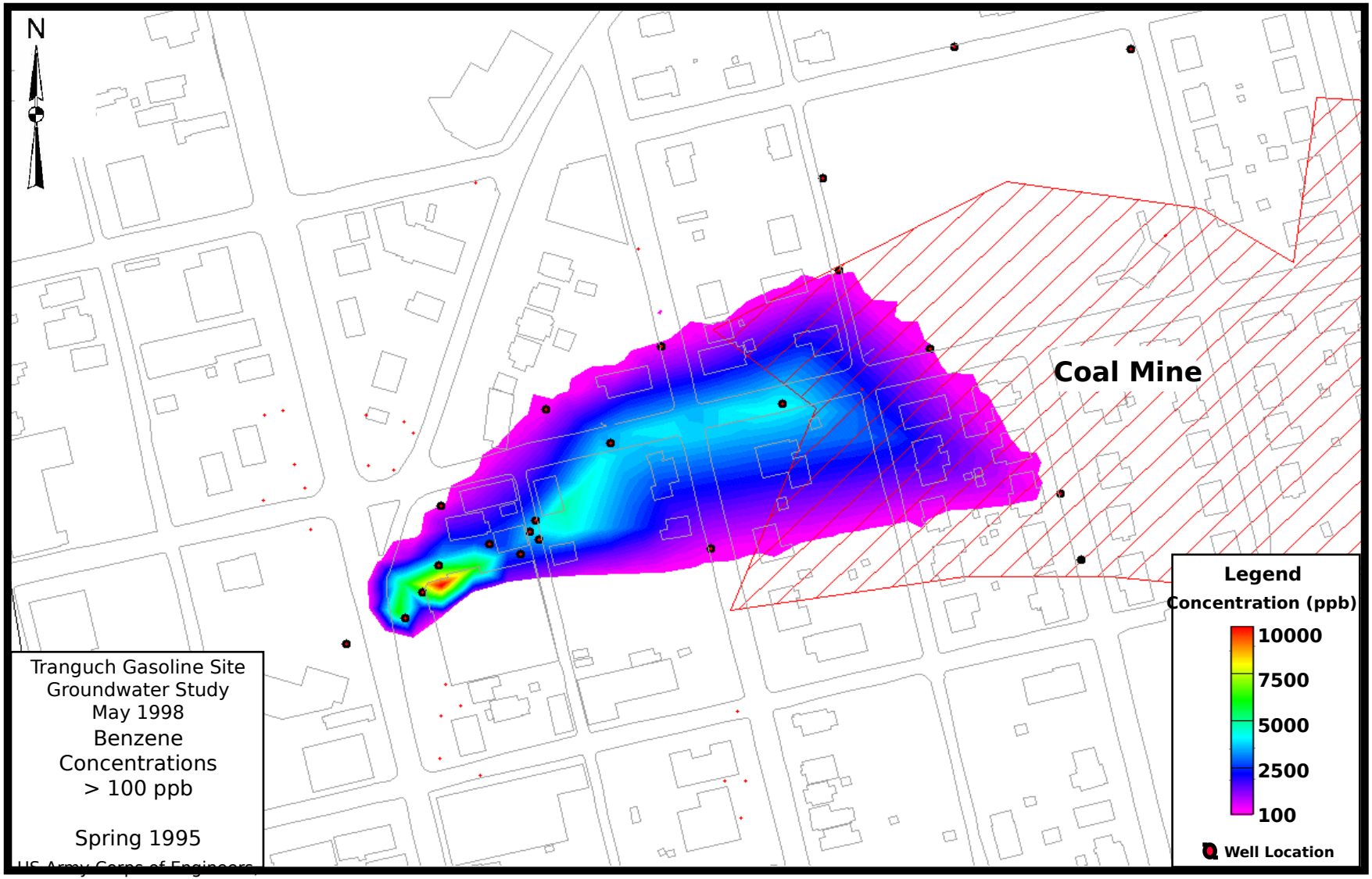


Slurry Wall



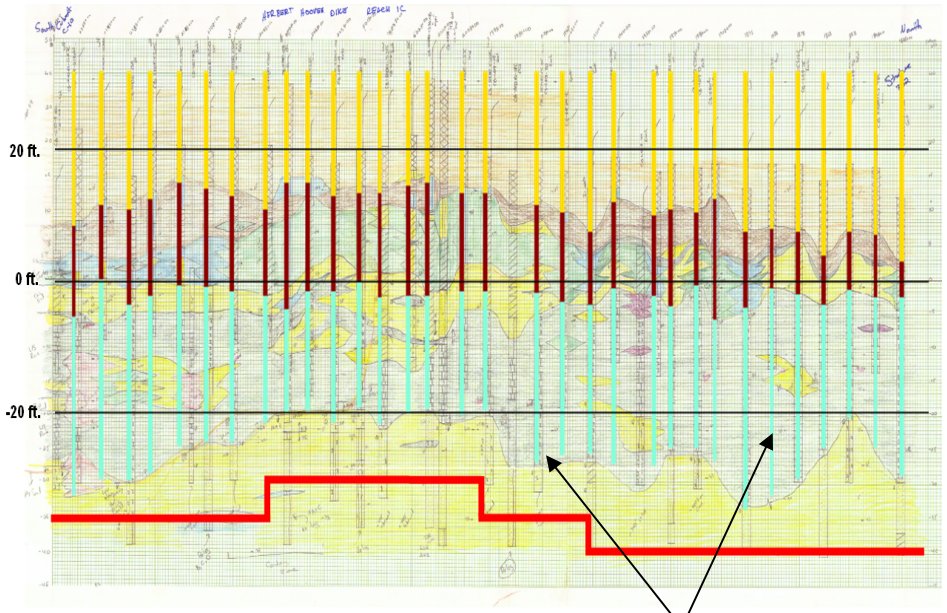
Data Visualization – Plume Plots

US Army Corps of Engineers
Philadelphia District



3-D Geologic Conceptualization

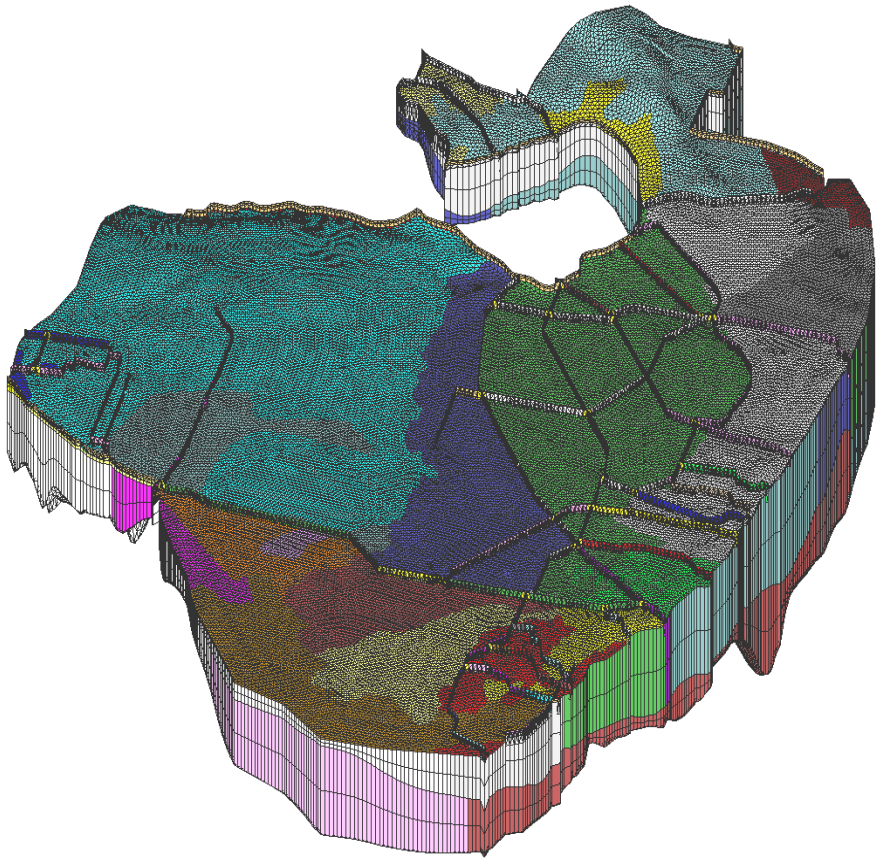
US Army Corps of Engineers
Philadelphia District



GMS Boreholes

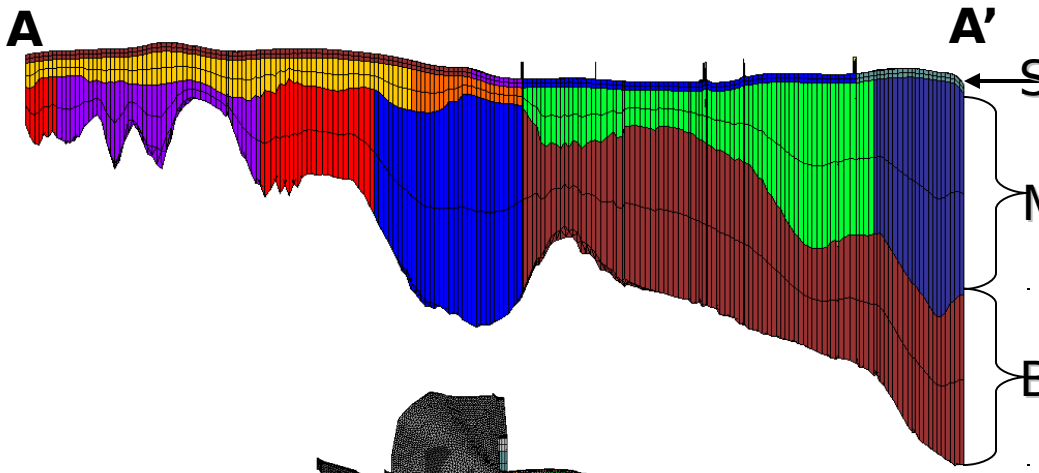
Borehole Materials

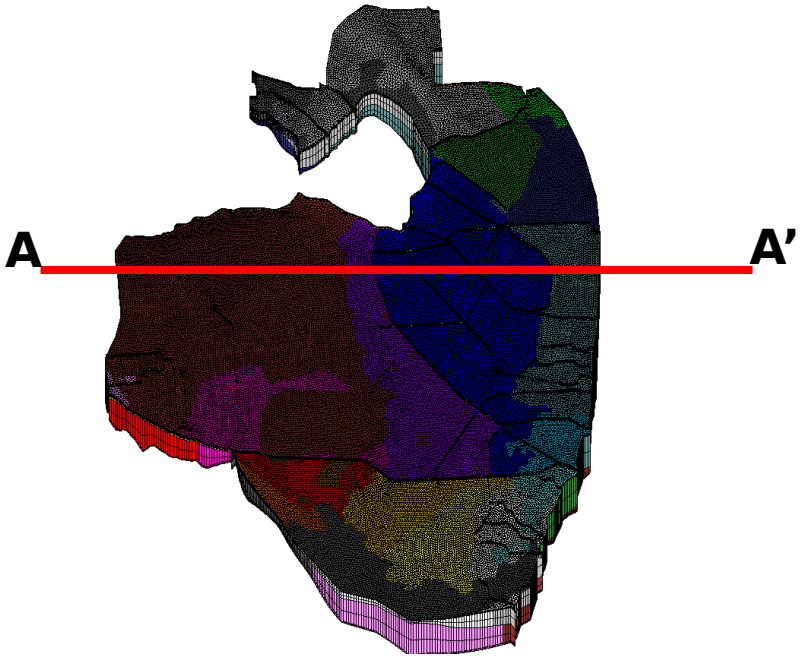
- **Layer 1 - undifferentiated**
- **Layer 2 - peat, clay, silt**
- **Layer 3A - limestone**



3-D Geologic Conceptualization

US Army Corps of Engineers
Philadelphia District



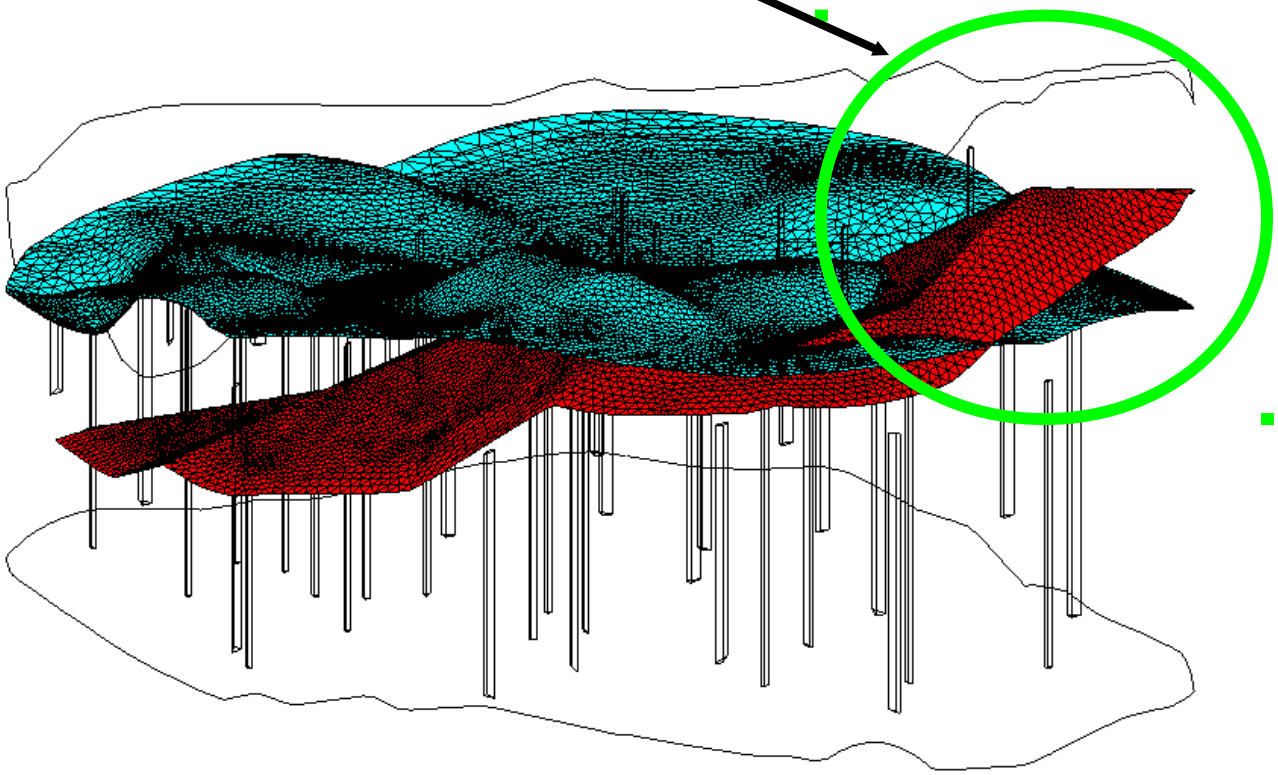


- The conceptual geology model was developed in 2005 by Jacksonville District based on Jacksonville District’s South Florida Digital Elevation Model Report

3-D Conceptual Models

US Army Corps of Engineers
Philadelphia District

Location of Unsaturated Trash



Legend

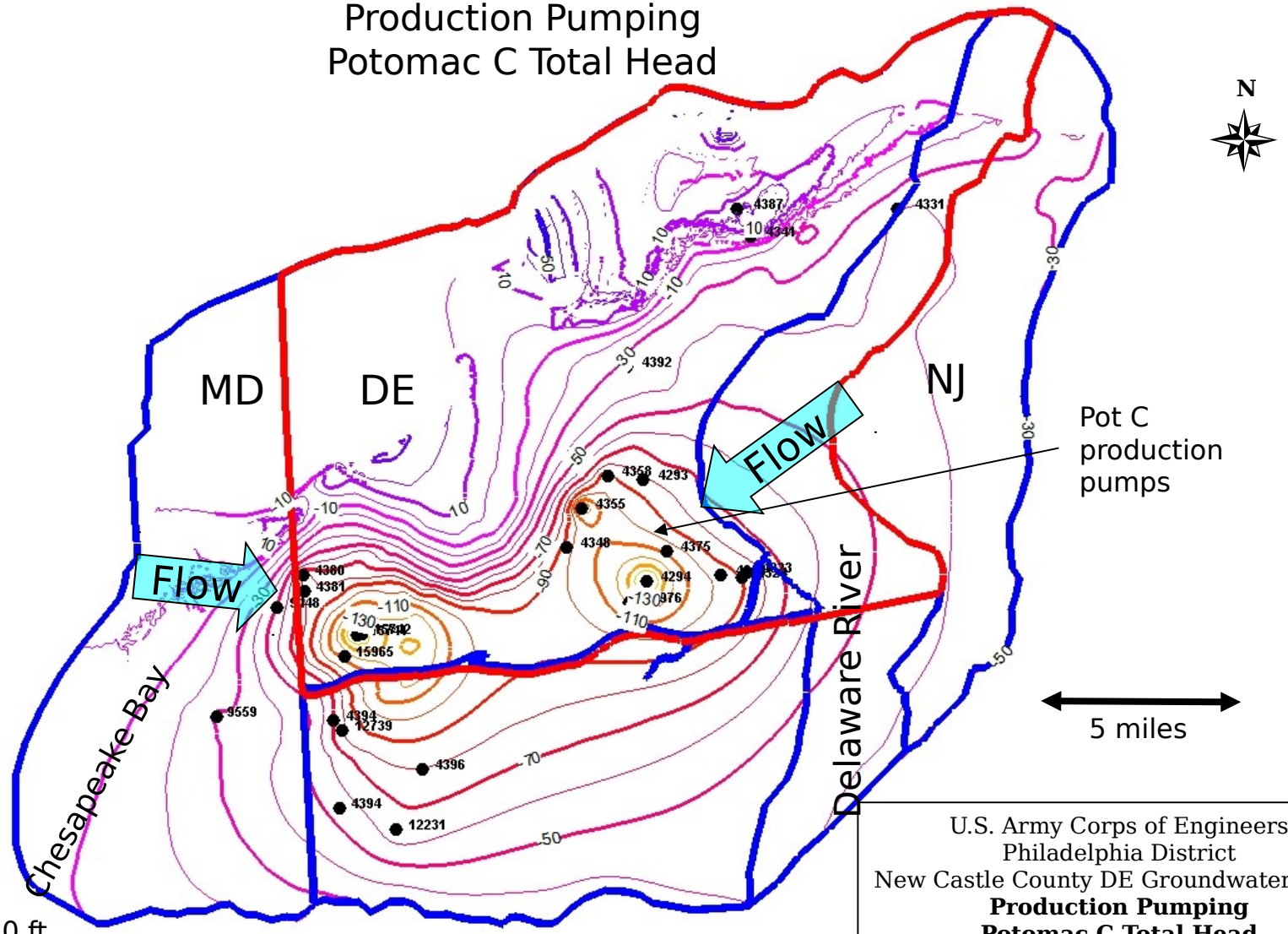
- Slurry Wall Location
- Surface of Bad Trash
- Water Table Surface

Lipari Superfund Site
Groundwater Study
2008

US Army Corps of Engineers,
Philadelphia District

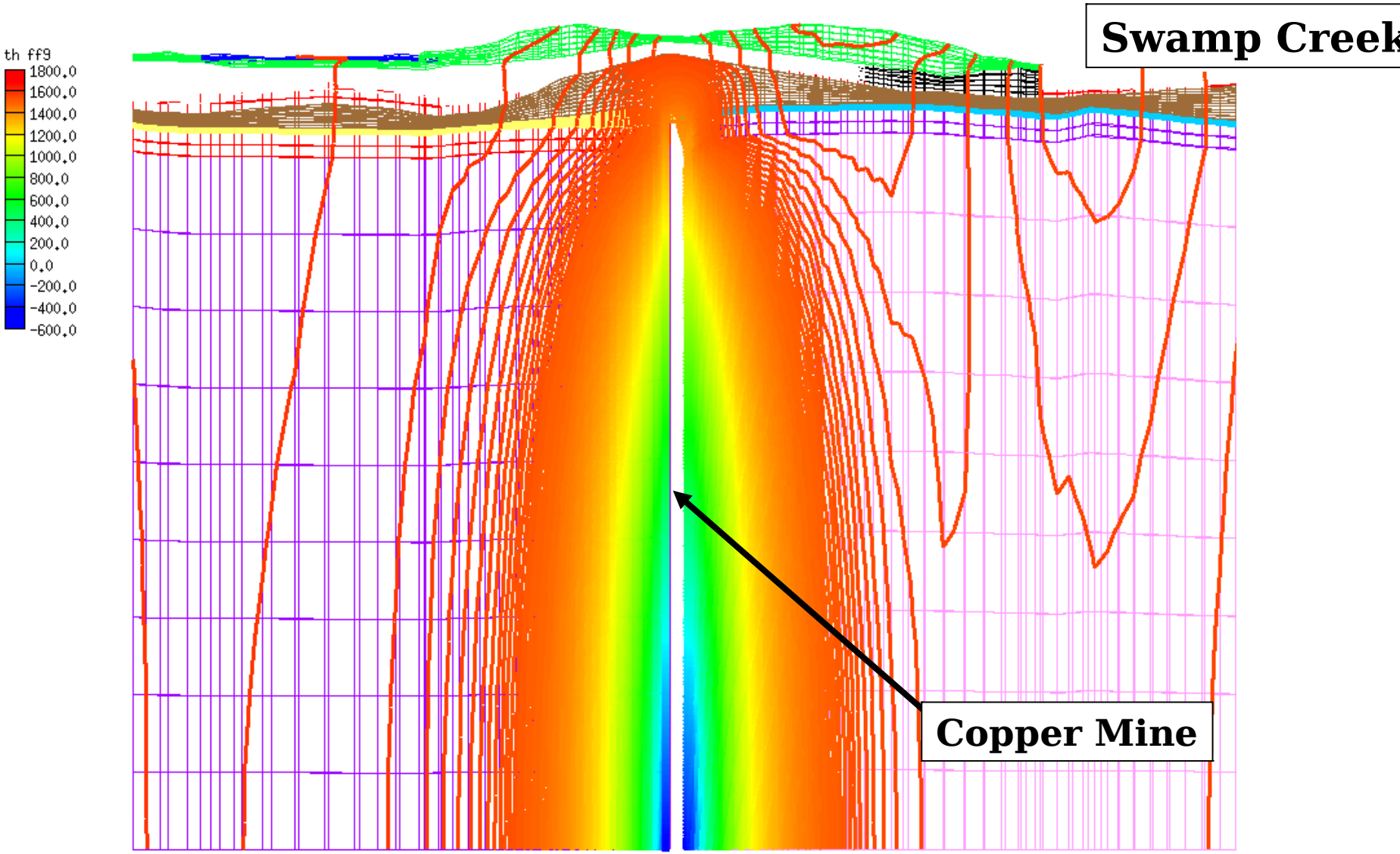
Flow Models – Water Supply

US Army Corps of Engineers
Philadelphia District



Flow Models – Wetlands Permits

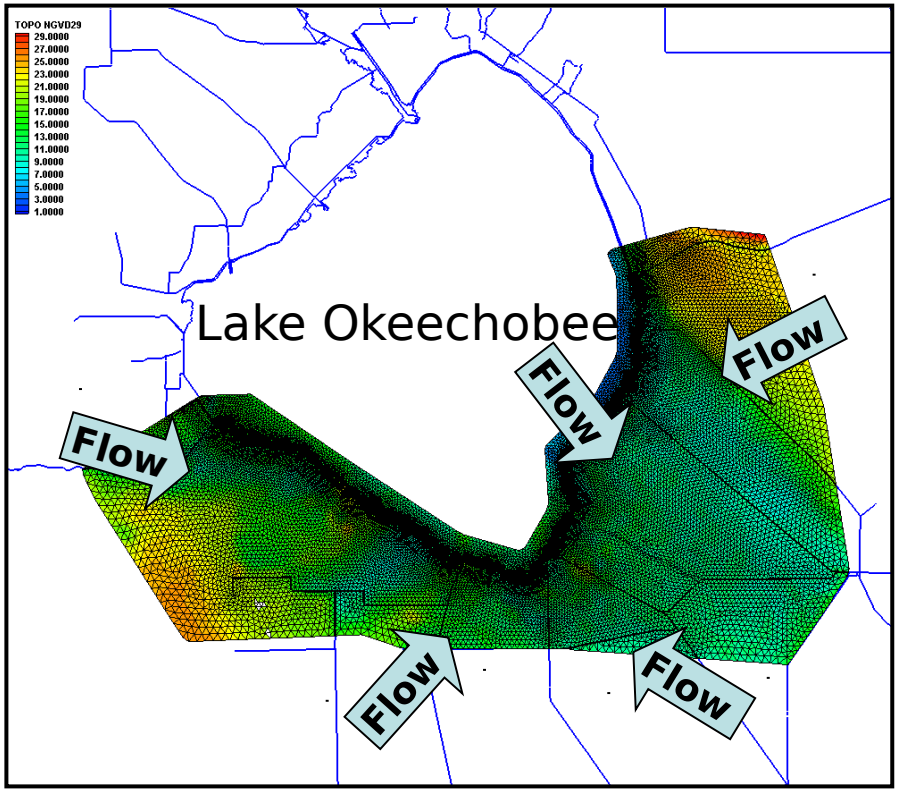
US Army Corps of Engineers
Philadelphia District

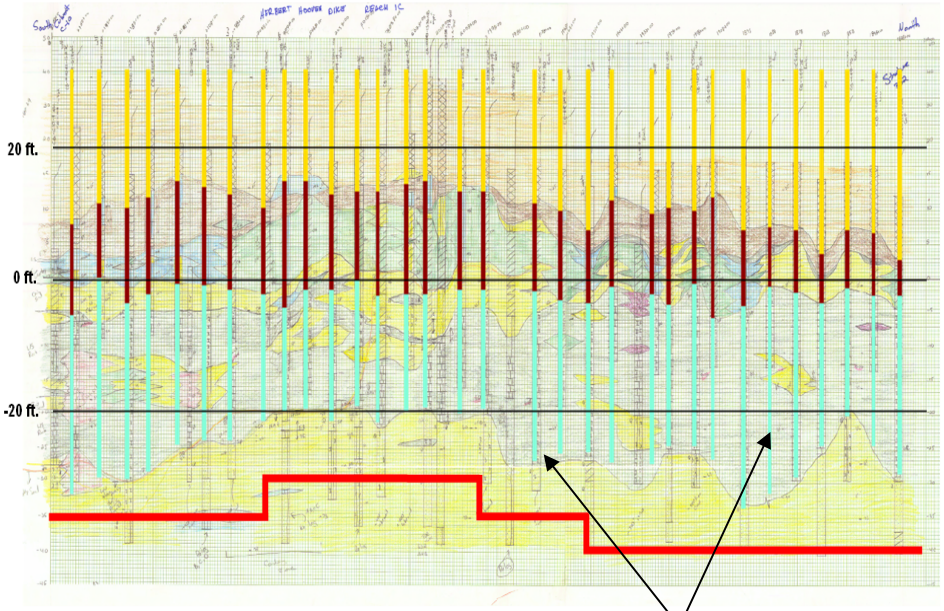


Flow Models – Design Analysis

US Army Corps of Engineers
Philadelphia District

Herbert Hoover Dike Regional Groundwater Flow Model





GMS Boreholes

Borehole Materials

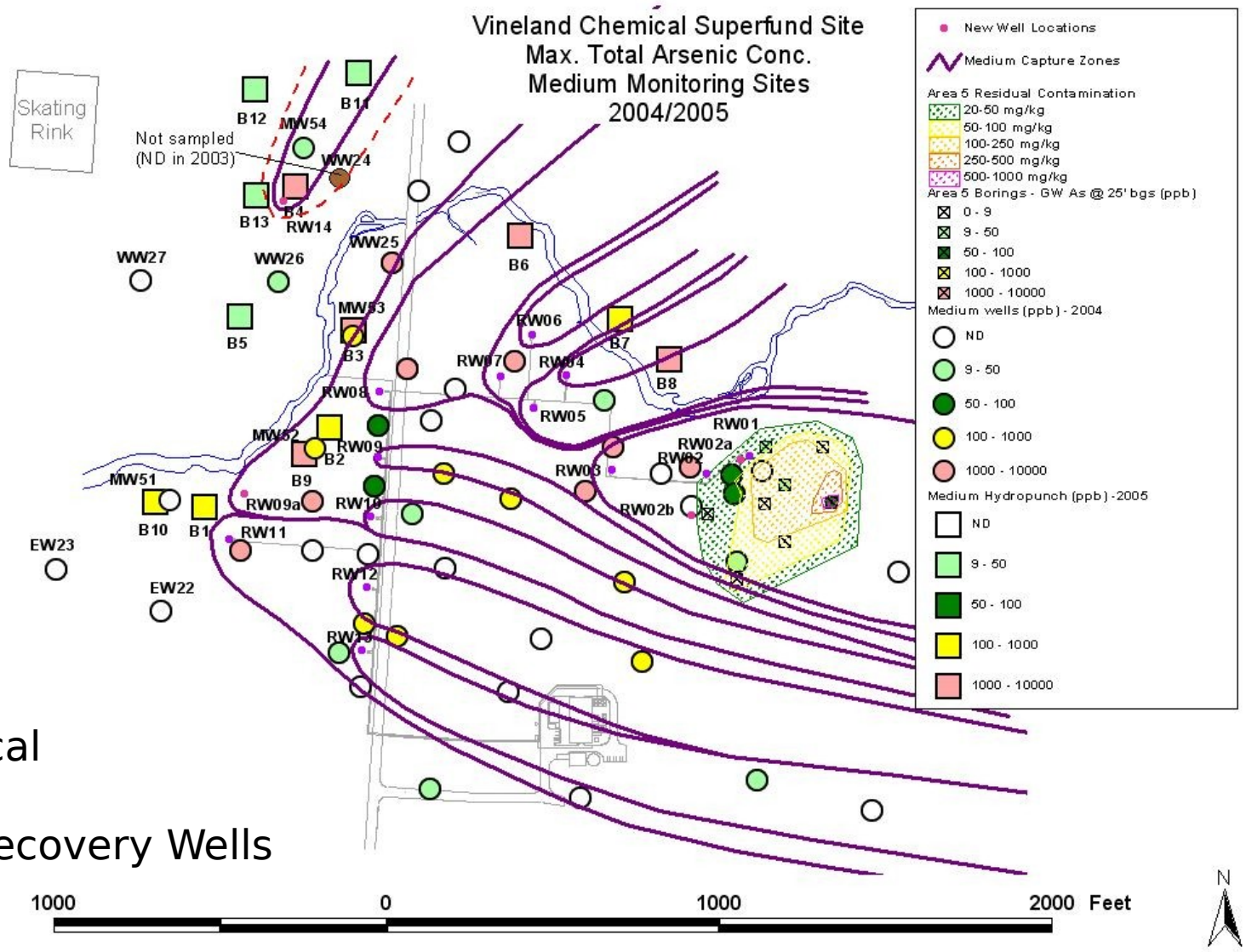
- **Layer 1 - undifferentiated**
- **Layer 2 - peat, clay, silt**
- **Layer 3A - limestone**

Proposed cut-of wall tip elevation (based on 02 MAR 2007 design)

Flow Models – Capture Zone Analysis

US Army Corps of Engineers
Philadelphia District

Well	GPM
RW01	0
RW02	0
RW03	60
RW04	30
RW05	50
RW06	30
RW07	40
RW08	50
RW09	15
RW10	25
RW11	50
RW12	50
RW13	30
RW09a	50
RW02a	50
RW02b	80
RW14	50
Total	660



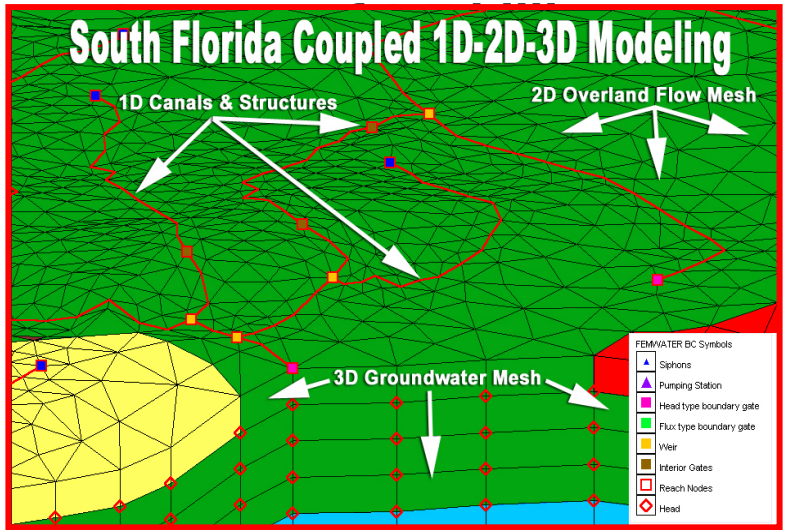
Vineland Chemical
Superfund Site
Proposed New Recovery Wells

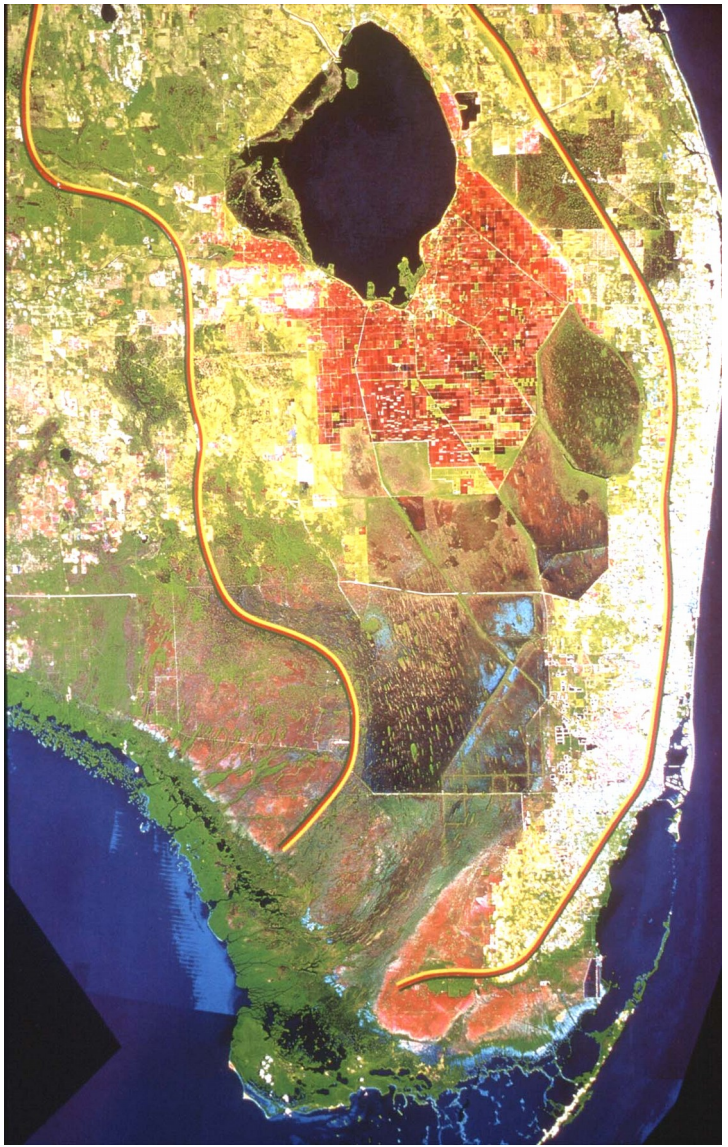
Flow Models – Surface/Subsurface Interaction

US Army Corps of Engineers
Philadelphia District

Everglades

- Too much/too little water for the Everglades/south Florida ecosystem
- Fragmentation of natural areas
- Degradation of water quality
- Population growth and increased demand

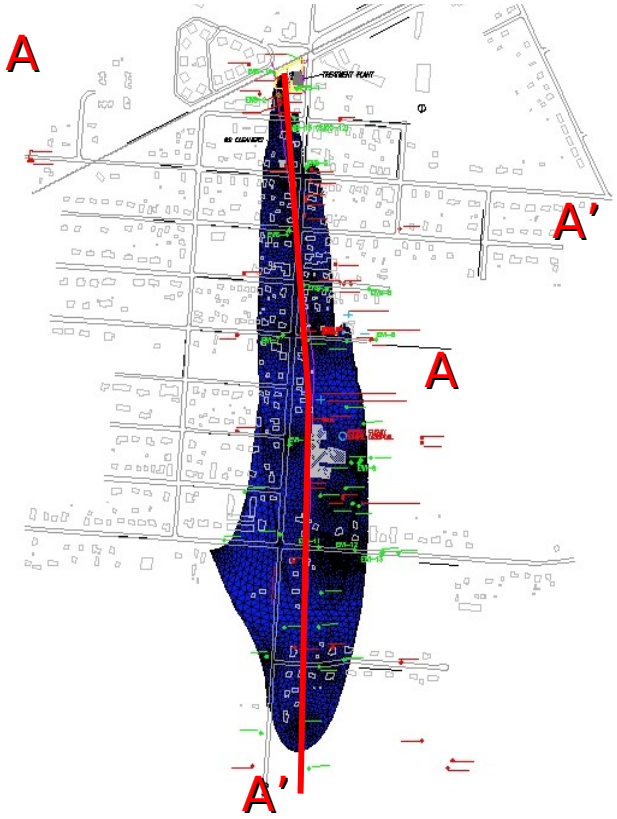


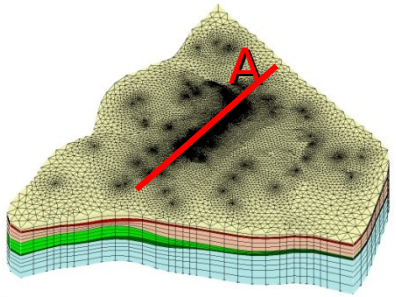


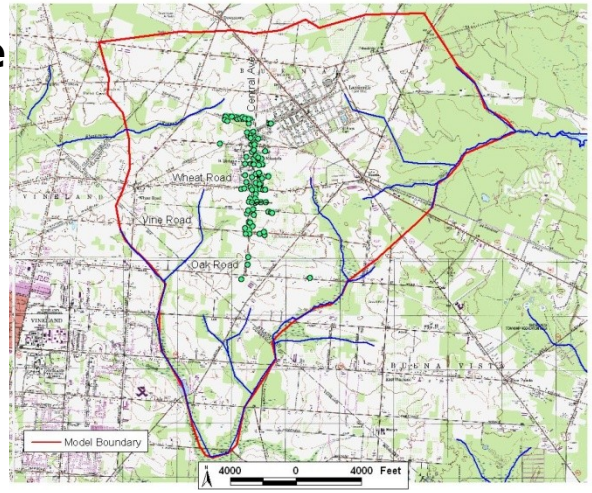
Contaminant Transport Modeling - Superfund

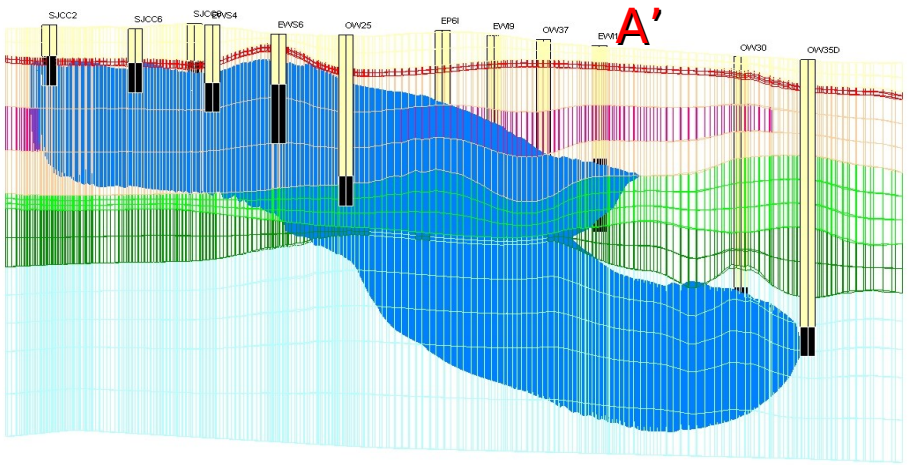
US Army Corps of Engineers
Philadelphia District

SJCC/GSC Superfund Site (NAP)









Upper Sand 1

Upper Sand 2

Banded Sand

Lower Clay

Lower Sand

Transport Run Resulting Plume – Cross Sectional View
July 1993 Flow Field, SJCC/GSC Superfund Site

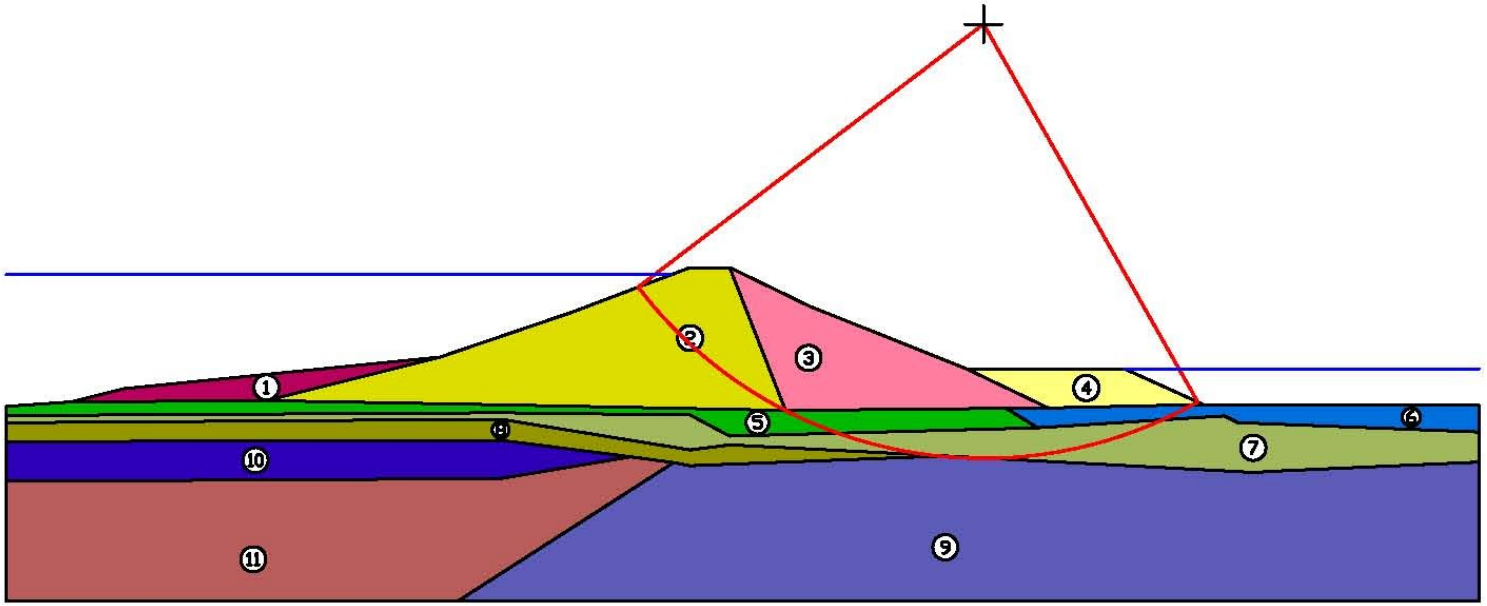
Dam Safety Analysis

US Army Corps of Engineers
Philadelphia District

JADWIN DAM
GLOBAL STABILITY ANALYSIS
CROSS SECTION 2
HIGH POOL, HIGH TAIL WATER, ANALYSIS A

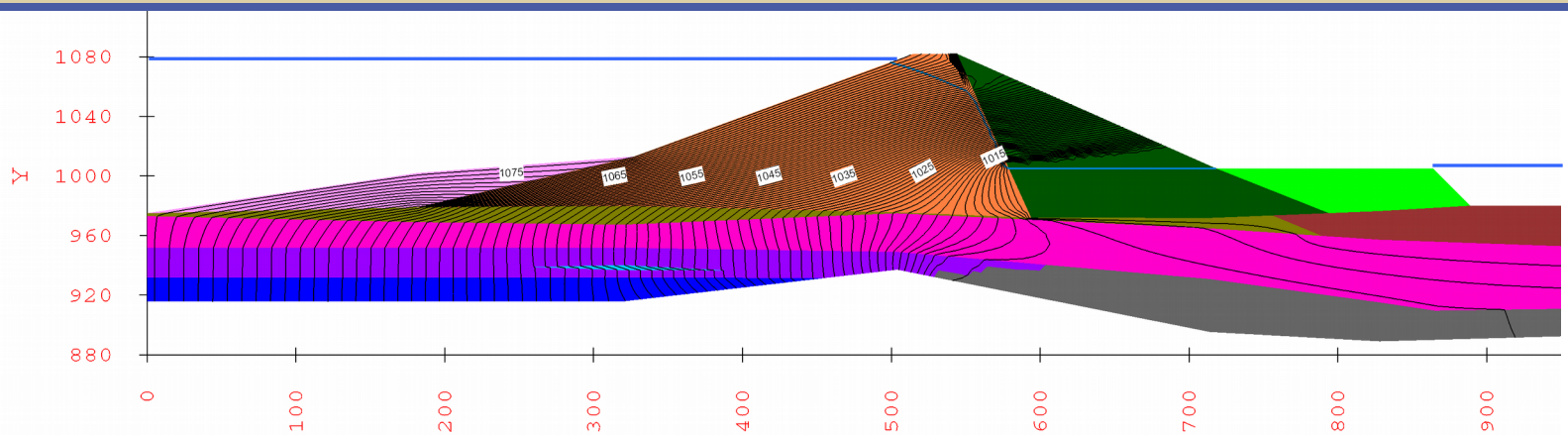
NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE	NO.	DESCRIPTION	UNIT WEIGHT	SHEAR STRENGTH	PORE PRESSURE
1	Earth Fill	120	Cohesion= 0.0 Friction angle= 37	Pore Pressure Interpolated	7	Sand	120	Cohesion= 2000.0 Friction angle= 13.3	Pore Pressure Interpolated
2	Earth Fill	128	Cohesion= 0.0 Friction angle= 37	Pore Pressure Interpolated	8	Gravel	120	Cohesion= 0.0 Friction angle= 36.8	Pore Pressure Interpolated
3	Rock Fill	122	Cohesion= 0.0 Friction angle= 45	Pore Pressure Interpolated	9	Gravel Boulders	130	Cohesion= 0.0 Friction angle= 36.8	Pore Pressure Interpolated
4	Rock Fill	122	Cohesion= 0.0 Friction angle= 45	Pore Pressure Interpolated	10	Silt	115	Cohesion= 500.0 Friction angle= 8	Pore Pressure Interpolated
5	Silty Sand	120	Cohesion= 2000.0 Friction angle= 13.3	Pore Pressure Interpolated	11	Sand Gravel	120	Cohesion= 2000.0 Friction angle= 13.3	Pore Pressure Interpolated
6	Sand and Gravel	120	Cohesion= 0.0 Friction angle= 36.8	Pore Pressure Interpolated					

Factor of safety= 2.130
Side force inclination= -10.46 degrees



Dam Safety Analysis

US Army Corps of Engineers
Philadelphia District



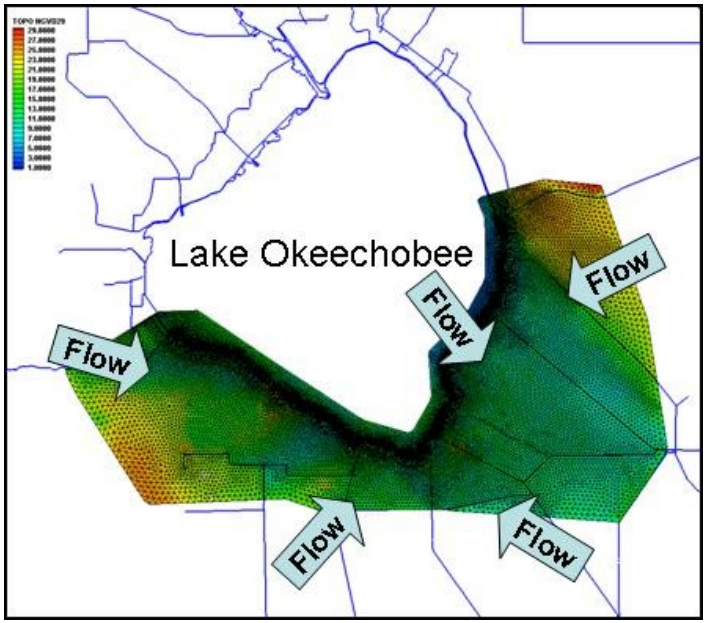
Design Flood
STA 10+25
High Tailwater
Conductivity Values – Set A

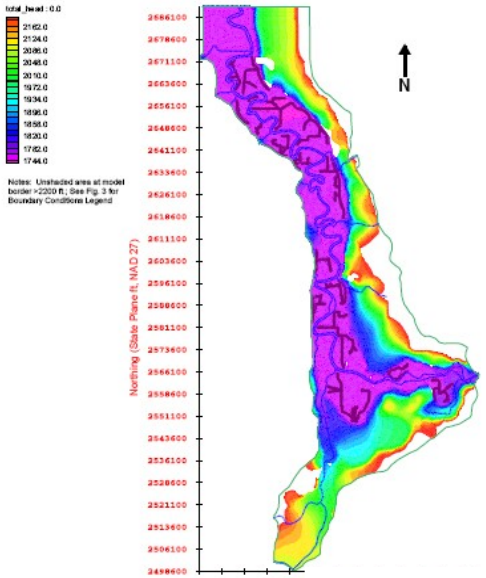
Material	Horizontal Hydraulic Conductivity (ft/d)	Vertical Hydraulic Conductivity (ft/d)
Uncompacted Earth Fill	0.05	0.005
Compacted Earth Fill	0.01	0.001
Dumped Rock Fill	1000	100
Dumped Rock Fill	300	30
Silty Sand	0.05	0.005
Sand and Gravel	10	1.0
Silty Sand	0.4	0.04
Sandy Gravel	1.8	0.9
Sand Gravel Boulders	100	5.0
Silt	0.005	0.0005
Silty Sand Gravel	0.5	0.05

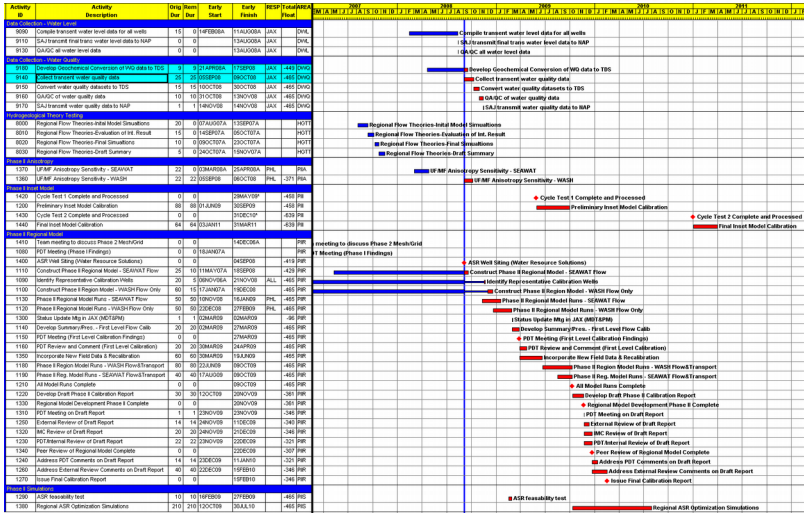
Services for A/E Contracts

US Army Corps of Engineers
Philadelphia District

- **SOW - Write or Review**
- **Prepare Gov. Estimates and Schedules**
- **ITR Contractor Products**



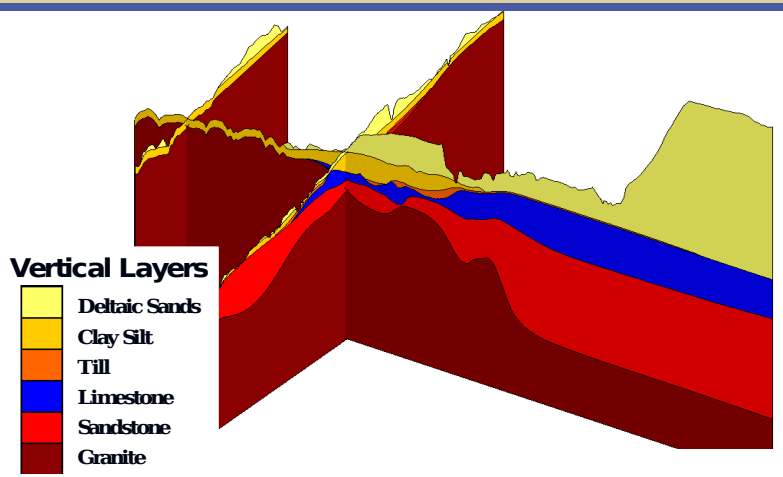


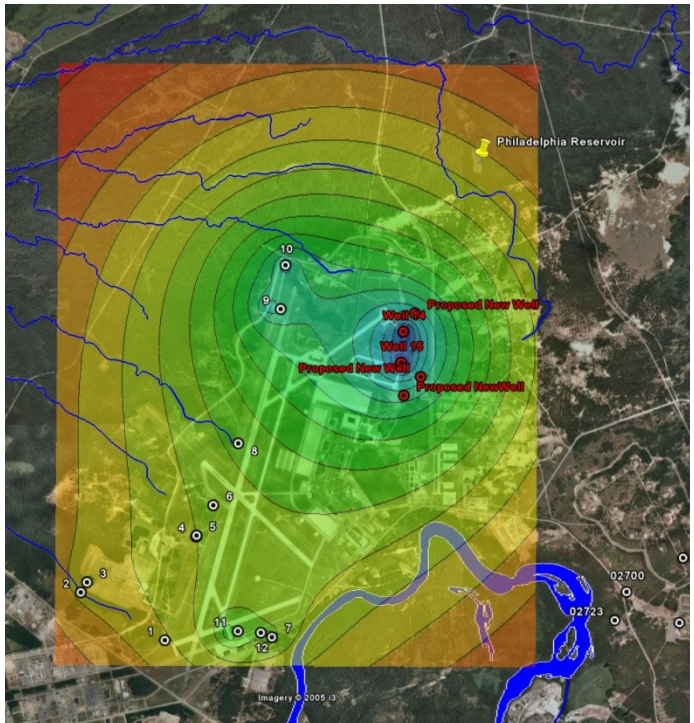


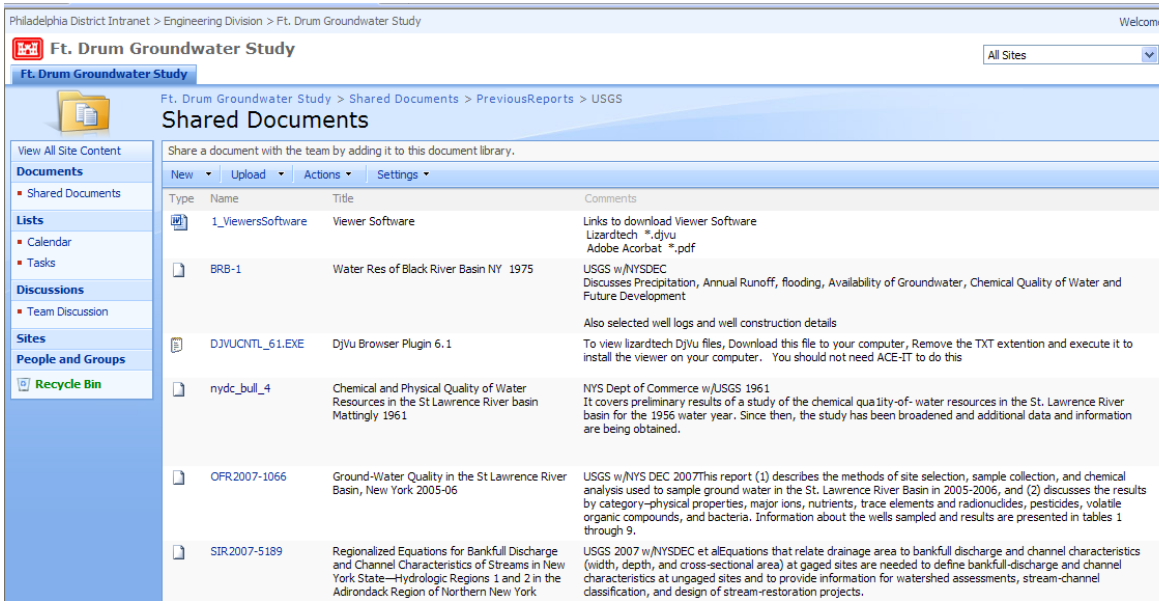
Ft Drum Case Study

US Army Corps of Engineers
Philadelphia District

- Collect Available Data
- Construct Conceptual Model
- Identify Data Gaps
- Draft Data Collection SOW

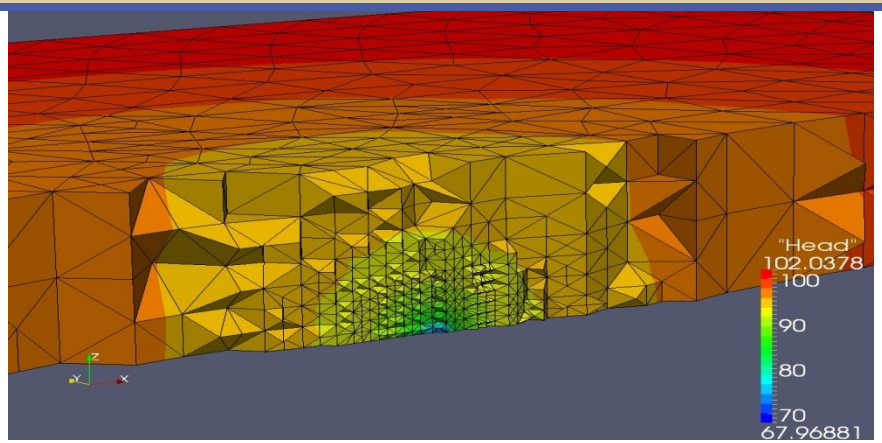






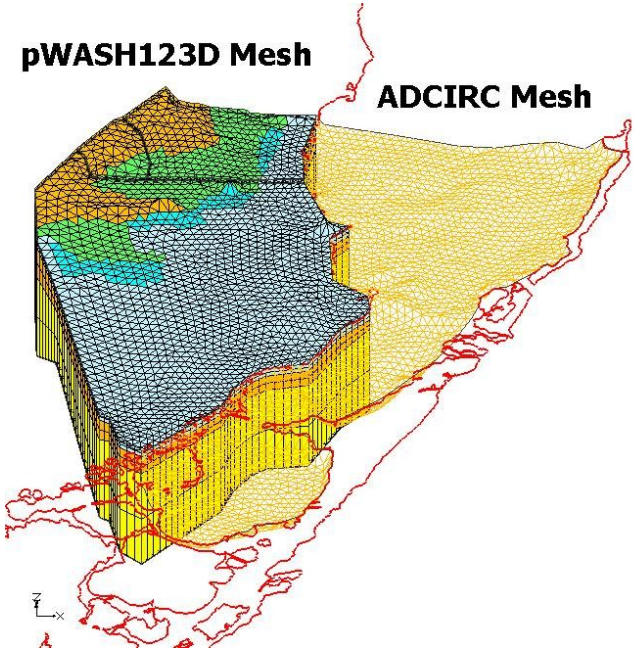
Modeling on the Cutting Edge of Technology

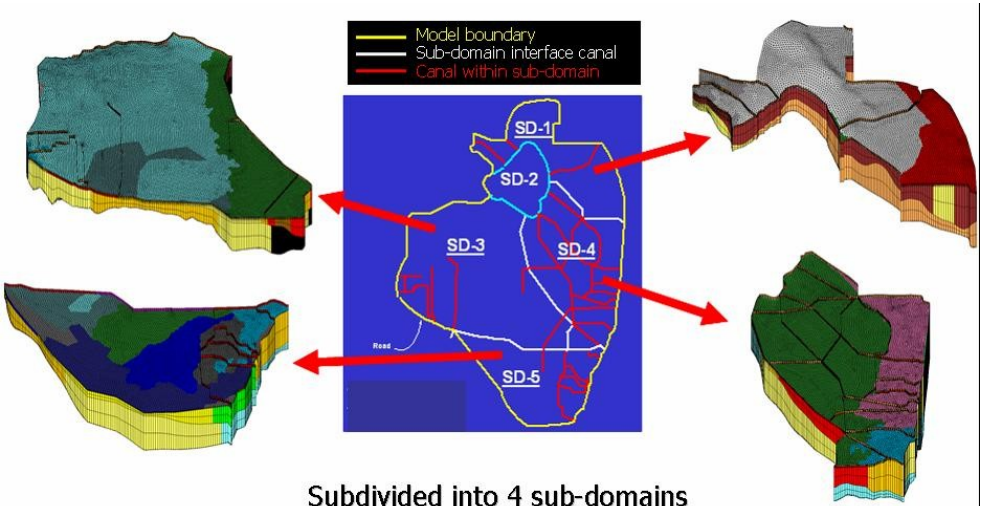
US Army Corps of Engineers
Philadelphia District



ADH

System-Wide Water
SWWRP
Resources Program





Subdivided into 4 sub-domains

Internal Technical Reviews (ITR)

US Army Corps of Engineers
Philadelphia District

Kootenia River ITR for NWS

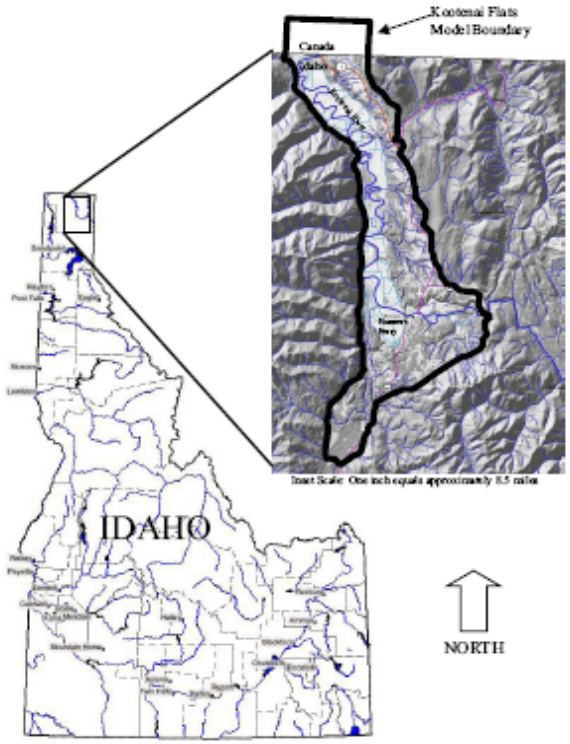


Figure 1. Site Map

